APPENDIX A

Statement of Work

04/16/03

"Federal Energy Management Program (FEMP) Project Support"

1.0 INTRODUCTION

The National Renewable Energy Laboratory is working in conjunction with the Federal Energy Management program, other National Laboratories, and Federal agencies to help agencies meet energy efficiency and renewable energy goals set by legislation and Executive Order. The Federal sector represents a significant market for energy efficiency, renewable energy technologies, and combined heat and power. Its annual energy bill is $3.6 billion dollars for buildings and another $5 billion dollars for transportation and industrial processes. The Federal sector offers a range of applications from demand-side to supply-side opportunities for energy technologies. There are 500,000 buildings in 8,000 locations world-wide in the Federal sector. Federal sector bases and facility campuses that use central plants or have remote operations offer significant supply-side opportunities. Agencies like the Department of Defense have considerable land holdings that offer opportunities for the use of renewable resources.

2.0 OBJECTIVE

The objective of this procurement is to obtain subcontractors with expertise in the six technology areas described below:

1. Solar Energy Systems (Photovoltaics and solar thermal),
2. Wind Power,
3. Sustainable Facilities Planning,
4. Building Modeling,
5. Building Commissioning and Monitoring, and
6. Distributed Energy Resources (including Combined Heat and Power)

The intent of the procurement is to establish task ordering agreements with a cadre of experts who will help NREL provide services to Federal agencies with the feasibility analysis, design, or integration of energy projects. NREL, supported by subcontractors, will be in a position to provide expertise on one or more technologies in an expeditious manner. NREL is interested in promoting the use of technologies in a technology-neutral fashion. NREL is developing this TOA in support of the DOE Federal Energy

Management Program (FEMP) to provide a flexible vehicle for agencies to obtain technical support from NREL with the implementation of energy projects.

3.0 SCOPE OF WORK

Under each of the technical areas, a sample task is given. The samples are technology specific for the purpose of assisting offerors in developing their proposal. These are samples for purposes of evaluating proposals and do not represent actual Statements of Work for task orders, although actual task orders may be issued based on these statements-of-work subsequent to award of each TOA.

Technical Area 1:

3.1 Solar Energy Systems Feasibility, Design, Integration and Supply

Subcontractors in this category will provide expertise and experience in solar energy system feasibility analysis and design integration. Solar energy technologies include photovoltaics, solar water heating, and solar ventilation air preheating. Subcontractors will provide Federal agency personnel with expertise in any of the following tasks: feasibility assessment; technical analysis; and systems design and integration. The system can be in remote or stand-alone applications or connected to the utility grid. Analysis capability includes the capability to: estimate energy requirements, simulate the performance of solar systems in different climates, given different loads, and compare options based on performance and cost trade-offs. The subcontractor will possess knowledge of state-of-the-art solar technology, available hardware, system installation and maintenance procedures and integration with an existing building architecture or landscape architecture and the building structure, mechanical and electric system (building-integrated PV). The subcontractor will also demonstrate familiarity with hybrid photovoltaic systems using wind or propane and be able to model those systems with software such as the NREL-developed HOMER (Hybrid Optimization Model for Electric Renewables). Subcontractor shall possess the capability to prepare designs including drawings and specifications as well as cost estimates. Subcontractor shall possess the capability to prepare procurement specifications for photovoltaic systems. Capability to render the appearance of building integrated PV design alternatives is desirable. Subcontractor shall advise Federal agencies on the codes and standards applicable to solar energy systems. Familiarity with federal procurement of solar power systems and balance-of-system products through the General Services Administration Federal Supply Schedule shall also be demonstrated.

The subcontractor may be asked to participate in one or more of three phases of service: Phase One: Feasibility Assessment; Phase Two: Technical Analysis; and Phase Three: System Design and Integration. The Phase One assessment will generally require less than one week. In Phase One, the subcontractor will be asked to participate on a team with individuals with expertise in renewable technologies to discuss the feasibility of solar systems for a given application. The subcontractor would be responsible for collecting enough data about the facility or site in order to make a preliminary assessment whether to pursue the option further and provide advise on potential implementation

strategies. Phase Two technical analysis is a preliminary assessment to determine the technical and economic feasibility of a specific project at a specific facility. The Phase Three effort involves design, integration and the development of procurement specifications for a solar or hybrid system. It also involves developing a procedure for on-going maintenance of the system at the facility. The Phase Three analysis would not occur until the client has explored several opportunities and made the decision that a solar energy system would meet their needs for a specific application.

Sample Task: Solar Energy Systems

Background:
The National Renewable Energy Laboratory has been requested to provide assistance to the National Park Service in the incorporation of solar water heating and photovoltaics for a new visitor center in New York City. The facility is provided with electric power from the utility, but does not have natural gas. The US DOE Federal Energy Management Program provides assistance to agencies implementing renewable energy projects at Federal facilities. This project is to support the NPS in meeting the requirements of legislation and Executive Order to maximize the use of renewable energy, such as solar, in cost-effective applications. The NPS also wishes to obtain a LEED rating for the building, and interested in renewable energy as a means to enhance the LEED score. This project is to support the NPS in evaluating and implementing on site solar energy systems on the new building.

Statement of Work:
Subcontractor shall interview NPS and design team staff to determine electric load requirements. Subcontractor shall confirm load estimate. Modeling indicates an electric load of 135,000 kWh/year and a peak demand of 48 kW. Subcontractor shall determine the size and specifications of all system components. Components shall be sized to minimize life cycle cost (initial cost plus life cycle operating costs, including fuel), but reliability shall be an important consideration for the design. System shall be designed for unattended operation. Subcontractor shall correspond with site staff to determine their requirements. Weather data for several locations in the surrounding area is available at www.nrel.gov. Subcontractor shall prepare system specifications for PV and solar water heating including: System Description; Performance Requirements; Equipment Specifications; Warranties and Equipment Life Expectancies; NEC and Other Code Issues. Subcontractor shall prepare electrical and plumbing drawings per the specifications. Subcontractor shall prepare and provide an operation, maintenance manual for the system. Subcontractor shall specify: PV array module type, size, number (if any), and configuration; battery type and size, number and configuration; size and type of inverter, charge controller, battery charger, automatic generator controls, generator, structural systems and enclosures, conductors conduit and any other appurtenances to make the system complete and operational. For the solar water heating system, subcontractor shall specify number and type of solar collectors, storage tanks, pumps, controls, piping and fittings, and all other appurtenances to make the system complete and operational. Subcontractor shall prepare specifications in sufficient detail for NPS to

order parts or complete systems off the GSA Supply Schedule or other suppliers, and to contract for the installation..

Subcontractor shall travel to the site to conduct commissioning and acceptance testing of the completed system and to provide training for operating staff.

Subcontractor shall prepare operations and maintenance manual. O&M Manual shall include: system description with schematic diagrams, modes of operation; performance evaluation; safety considerations; preventative maintenance; troubleshooting and corrective action; repair/replace criteria; list of replacement parts; and cut sheets on major components.

Deliverables and Schedule:

1) Conceptual Design: Subcontractor shall submit conceptual design with system schematic diagram and major component sizes.
   Due: Three weeks after subcontract award.

2) Completed Design: Subcontractor shall submit completed design with written specifications and drawings.
   Due: Six weeks after subcontract award

3) Installation Report: Subcontractor shall submit final report with photographs of the system and complete and a record of obstacles and issues delaying or impeding installation.
   Due: Two weeks after installation of system

4) O&M Manual: Subcontractor shall submit 4 copies of operations and maintenance manual. O&M Manual shall include: system description with schematic diagrams, modes of operation; performance evaluation; safety considerations; preventative maintenance; troubleshooting and corrective action; repair/replace criteria; list of replacement parts; and cut sheets on major component
   Due: Upon installation of system

Technical Area 2:

3.2 Wind Power System Feasibility, Design, Integration and Supply

Subcontractors in this area must have experience and expertise in wind-power systems analysis, design, integration, developing system specifications, and on-going maintenance programs for small and commercial scale wind turbines. They will provide Federal agency personnel with expertise in the feasibility assessment, technical analysis, and systems design and integration. The subcontractor will also provide assistance in the design of a program for on-going system maintenance for a wind-power system in remote or stand-alone situations or connected to the utility grid. Analysis capability includes the ability to simulate or assess the performance of wind power systems in different wind zones for different loads and comparison of options based on performance and cost trade-offs. The analytic capability also includes the ability to collect wind data at the site and

determination of the best site for a system. The subcontractor will provide assistance with available hardware, system installation and maintenance procedures. The subcontractor will also work with hybrid systems such as wind/PV and be able to model them using software such as the NREL-developed HOMER (Hybrid Optimization Model for Electric Renewables). In addition, the subcontractor will assist in utility interconnect issues and will properly scope system cost impacts of the interconnection. The subcontractor will provide knowledge of cognizant Federal green power purchasing programs or other innovative procurement mechanisms, as well as Federal procurement issues.

The subcontractor may be asked to participate in one or more of three phases of service Phase One: Feasibility Assessment; Phase Two: Technical Analysis; and Phase Three: System Design and Integration. The subcontractor will be asked to participate on a team with individuals with expertise in renewable technologies to discuss the feasibility of wind systems for a given application. The subcontractor would be responsible to collect enough data about the facility and the available wind resource in order to make a preliminary assessment whether to pursue the option further and provide advice on potential implementation strategies. Phase Two is an analysis to determine the technical and economic feasibility of a specific project at a specific facility, including utility impacts/issues. Subcontractor shall provide advice and assistance with identifying required environmental permits or assessments and shall provide information to assist in the preparation of assessments or impact statements. Phase Three project support involves design, integration, and the development of procurement specifications for a wind or wind-hybrid system. It also involves developing a procedure for on-going maintenance of the system at the facility. The Phase Three analysis would not occur until the client has explored several opportunities and made the decision that a wind or wind/hybrid system would meet their needs for a specific application.

Sample Task: Wind Energy Systems

Background:
The National Renewable Energy Laboratory has been requested to assist the US Coast Guard in the evaluation of wind energy potential at Coast Guard facilities on Kodiak Island, AK. The facility is provided with electric power from an island utility, which would necessarily be involved in any subsequent wind energy development attached to it's system. This project is to support the USCG in evaluating and implementing on site wind energy systems on the island.

Statement of Work:
Subcontractor shall interview USCG and staff of Kodiak Electric Association to determine electric load requirements and the needs and limitations of the project.. Subcontractor shall identify and select the most promising wind sites on Kodiak Island. Subcontrator shall install wind metering equipment onto existing CG towers, or new towers. Subcontractor shall install and program data acquisition systems. Subcontractor shall collect, archive, validate and process collected data in accordance with NREL standards. Subcontractor shall assess local wind variability using more generalized regional wind data and history to determine if the collected data may be considered

representative of long term wind resources. Subcontractor shall assess wind energy project economic and technical feasibility according to Federal criteria. Feasibilty study shall identify optimal size, type and number of wind turbines, locations of wind turbines, installation and operating cost estimates, energy delivery and revenue estimates. And life cycle cost analysis according to Federal criteria. Feasibility study shall also consider other issues which may delay or impede implementation such as the National Environmental Policy Act or the National Historic Preservation Act. Subcontractor shall prepare written report containing results and recommendations.

Subcontractor shall travel to the site to collect data and install monitoring equipment and to meet with on-site staff.

Deliverables and Schedule:

1) Letter report describing integration of wind with island electrical system, USCG loads.
   Due: One month after subcontract award.

2) Letter report identifying candidate sites for wind development and wind anemometers.
   Due: Two months after subcontract award.

3) Letter report with photos documenting installation of anemometers.
   Due: Four months after subcontract award.

4) Letter report with wind data measurements and regional wind study.
   Due: 16 months after subcontract award.

5) Feasibilty study of wind power for Kodiak Island.
   Due: 20 months after subcontract award.

Technical Area 3:

3.3 Sustainable Facility Design and Planning Services

Subcontractors in this category will work with Federal building owners and their architect/engineering firms primarily in the programming, schematic generation, and design development stages of a building's design or major remodel. They also will work with existing facilities to develop plans to improve sustainability of existing operations. They will also assist a Federal facility manager in securing A/E services which emphasize sustainability as a goal and as a value. Subcontractor will facilitate, or participate in, design charrettes for single buildings or entire facilities. For the Charrette, the subcontractor shall convene a team of topical experts to facilitate development of solutions along with staff from the facility. The subcontractor will be responsible to ensure that the impact of design decisions in terms of energy use are fully understood by the design team and taken into consideration at all stages of design. The subcontractor will ensure that a design approach treats the need for heating, cooling and lighting in an integrated fashion, not as independent elements.

Based on their knowledge, Subcontractors will provide assistance in the following sub-categories: the sustainable/low energy design process, integration of daylighting/energy-efficient lighting, and HVAC issues related to sustainable building design. The Subcontractor will provide assistance with passive solar and sustainable products, materials and design concepts, as well as t experience with existing design and simulation tools. Experience with a range of building types, renewable energy technologies, and water conservation will be demonstrated. Subcontractor shall advise Federal agencies on impacts and interactions between energy, materials use water and wastewater, site planning, solid waste and wastewater management, transportation, and any others areas affecting facility resource use and efficiency. Subcontractor shall be familiar with sustainability rating systems such as LEED by US Green Buildings Council and other standard indicators of sustainability. Subcontractor shall provide LEED ratings and provide associated advice to agencies. Subcontractor shall assist Federal agencies in setting sustainability goals and establishing action plans to meet the goals.

The subcontractor may be asked to participate in one or more of three phases of service. Phase One, Feasibility Assessment, will require approximately one week of subcontractor effort. The subcontractor will be asked to assist the Federal client in conceptualizing the project and assessing the anticipated energy loads in the building and opportunities for sustainable building design. The objective of the service is to characterize the energy situation and possible solutions to assist the Federal client to determine how to proceed with either the development of a solicitation for bidders, or in-house building programming and design. The result of this phase of service would be a decision whether or not to go forward with the project.

Phase Two, Technical Analysis, is a more detailed assessment of the "energy problem" in the proposed building. This is an analysis based on the architectural program that defines how energy will be used in the building. The analysis will be used to lead the architectural/engineering team to the range of appropriate renewable solutions. Phase Three, Design and Integration, will involve working interactively with the project's architect and engineers to evaluate energy design solutions and assist them in integrating these solutions with other building criteria. A Phase Three analysis involves more in-depth design integration. The Phase Three analysis would not occur until the client is committed to designing a sustainable building. (Although the description herein refers to new construction, the scope of this task applies to major renovation of an existing building as well.)

Sample Task: Sustainability Planning

Background:
This task is to conduct a planning activity known as a “Charrette”. The Charrette activity will consist of preparatory research and planning, conducting a workshop, and preparing a report. Sustainability Planning Exercises or Environmental Design Charrettes result in near-term, mid-term, and long-term recommended actions which move a specific facility

and/or site towards their goal of reducing energy use 35% by the year 2010 and the other goals of EO 13123, including those relating to sustainable building design (section 403 (d)). Charrettes focus attention on the narrow windows of opportunity, when decisions affecting the use of resources are made, with an emphasis on actions that can be taken immediately. Charrettes bring together decision-makers from the facility and agency, regional stakeholders, utility and industry partners, and technology experts to form a multidisciplinary team.

Statement of Work:
The subcontractor shall plan and organize a half to one-day, on-site planning meeting at the identified site to design, coordinate, and conduct the two-day charrette. The subcontractor shall include key site and regional personnel assembled into a Charrette Planning Committee. The subcontractor shall lead the committee in establishing basic background information, clarifying goals and objectives (developing charrette conditions, charrette requirements), and ensuring support for these goals and objectives. The subcontractor shall submit a meeting report including the basic background information, goals, and objectives articulated from the planning meeting.

The subcontractor shall form a team to design a charrette that includes content experts and instructional design experts who can share past successes and "Lessons Learned" from other facilities. The team shall be selected for their technical qualifications, their presentation skills, and their real-world experience that is similar to that of the audience. The subcontractor shall facilitate the sessions. The subcontractor shall provide overall charrette facilitation, through the expertise and perspectives of environmental leaders and financial experts and results-based templates to focus breakout sessions on desired outcome(s). The subcontractor shall have talented personnel assigned to take notes and record on flip charts to ensure that an accurate summary of the charrette process and proceedings. The team shall create results-based templates to focus the breakout session and given to the NREL technical monitor for review. The templates shall consider issues of benchmarking, identification of champions, obstacles and opportunities, financial factors and options, existing initiatives, potential partnering, etc. The subcontractor, with input from the team, shall draft the agenda to suit the goals and objectives of the charrette. After review by the NREL technical monitor, the subcontractor shall submit the final agenda. The subcontractor shall develop an invitation letter, create and manage the invitation list, contact and screen potential participants, and encourage participation. The subcontractor shall conduct a two-day charrette for approximately 30 participants to be held at the identified site. The subcontractor shall provide the logistical and/or administrative support needed for a successful charrette including the location, negotiation, and payment of the venue, meeting rooms, audiovisual/other equipment, and recording of the charrette using graphics and text. The subcontractor shall prepare and distribute a participant notebook containing the agenda, copies of slides, materials used in the hands-on exercises, and other resources, as appropriate, that participants can use for future reference. The subcontractor shall accurately capture a record of the proceedings of the charrette both in legible text and using graphics. The subcontractor shall provide a written report of the Charrette with Executive Summary, charrette results, financing options, and next steps in the sustainability process, recommendations, resources needed

for implementation, and a schedule identifying near-term, mid-term, long-term actions, organizations associated with each action, and windows of opportunity. The report should be visually exciting, informative, and stimulating including visuals such as photographs, diagrams, and other illustrations.

Schedule and Deliverables:

1) Charrette Participant Notebook with agenda and evaluation forms.
   Due: Eight weeks after contract award

2) Charrette Report including completed evaluations by participants.
   Due: 10 weeks after contract award.

Technical Area 4:

3.4 Building Energy Modeling, and Analysis

Subcontractors in this category will provide the expertise and experience to quantify energy use in a building or complex of buildings and to estimate, analyze and evaluate the efficacy of Energy Conservation Measures (ECMs) including glazing and envelope measures, HVAC measures, lighting measures, renewable energy, equipment efficiency, and co-generation technologies. Expertise with DOE2.x, Energy10, and FRESA energy analysis programs will also be provided to model whole-building interactions between envelope, mechanical and lighting systems and for preliminary screening of renewable energy opportunities.

The subcontractor may be asked to participate in one or more of three phases of service Phase One: Energy Modeling and Evaluation; Phase Two: Energy Conservation Measure Analysis; Phase Three: Engineering support.

Early in the design of a building modeling may be used to set energy use goals based on a "shoebox" model. Subcontractor may be required to establish a "basecase" by modeling a building with the minimum requirements of ASHRAE 90.1 or other baseline standard. Subcontractor will model the emerging design and inform designers of the energy use implications of design decisions. The subcontractor will be required to work with others on the design team to ensure that the results are timely and useful to the design team. Subcontractor shall provide screening for cost-effective opportunities of using renewable energy

CM Analysis involves the development of an energy use reduction and equipment retrofit concept for the site. This includes the technical and economic feasibility analysis of alternative solutions such as energy efficiency, renewable energy, and cogeneration. The subcontractor must be able to adequately model the buildings to simulate and correlate the performance of the existing HVAC system and its power use and to incorporate suggested equipment upgrades in that model. The analysis may include the conceptual design, integration and, if required, the development of procurement specifications for suggested equipment upgrades. The identification of utility billing concepts and issues

will also be necessary. Engineering support will provide support to NREL in the review and evaluation of design submittals by outside contractors.

Sample Task: Building Modeling

Background:
The Federal government is planning to build a new 300,000 sf office building which includes 2000 sf daycare room, 1000 sf cafeteria, and 10000 sf laboratory space in Salt Lake City Utah. The building will be adjacent to an existing 500,000 sf Federal building.. They have requested the assistance of the Federal Energy Management Program (FEMP), through the National Renewable Energy Laboratory, to advise them on how to make the building a showcase of energy efficiency and renewable energy, as well as support sustainable demonstration project goals. The design should be an exemplary sustainable building, which includes sustainable design principles.

Statement of Work:
Subcontractor shall conduct a project kick-off telephone conference call with project officials, NREL staff and design professionals to review or establish overall goals for the project; review work done to date; review and revise the RFP for design services; develop a timeline for soliciting and selecting a design team and designing and constructing the project; and identify additional sources of funding for the project. Subcontractor shall advise the team on the requirements for architectural and engineering design services to address the intent of having the building be a sustainable design demonstration project. Subcontractor shall prepare recommendations for language for statement of work, and language for selection criteria to assist the government in selecting and contracting a design team with the capability and the past performance indicative of that required to deliver an exemplary design. Subcontractor shall assist (as a voting or non-voting member) review the proposals submitted by architectural and engineering firms and rank the firms in order of qualification. Participate, as appropriate, in the interviews of the top three ranked firms. Provide advice and assistance, as required and appropriate, during the professional fee negotiating process. Subcontractor shall participate in a programming workshop (1 day) to establish the design goals, design criteria, architectural program, and sustainable design strategies for the project. In collaboration with the design team and the client team, subcontractor shall develop and integrate recommended sustainable design strategies into one or more schematic design solutions for the new Community Center. Subcontractor shall establish basecase energy use by preparing a DOE2 model of a code (ASHRAE 90.1) compliant basecase with the same floor area, climate, and use patterns as called for in the building program. Subcontractor shall evaluate various daylighting strategies to aggressively daylight the majority of the building spaces (as appropriate to their unique functional design requirements), as well as other sustainable design concepts – high performance glazings, renewable energy systems (solar DHW and photovoltaics), high efficiency lighting and HVAC systems, and sustainable materials. Subcontractor shall create a DOE-2 model of three proposed schematic design alternatives, calculate energy performance, and compare against the energy design goal. Subcontractor shall advise design team on revising energy and environmental design goals as appropriate. Subcontractor shall attend design team meetings, as required, to

develop and integrate sustainable design strategies and to present sustainable design aspects of the schematic design. Subcontractor shall fine-tune sustainable design concepts, including daylighting systems, glazing materials, lighting and HVAC system controls, sustainable materials, etc. through detailed energy and daylighting analysis, computer modeling, and material evaluation and selection. As design develops, subcontractor shall revise the schematic design DOE-2 model to reflect design development changes, calculate energy performance, and compare to energy design objective. Subcontractor shall attend design team and client meetings, as appropriate, to refine sustainable design features and to present sustainable design aspects of the design development solution. Subcontractor shall provide advice on sustainable design feature construction detailing, specifications, and material selection. Subcontractor shall revise DOE2 model to calculate energy performance of final design and compare to goals.

Deliverables and Schedule:

1) Project Management Report: Recommended language to assist in selecting and describing required architectural and engineering services. Include results of basecase DOE2 model.
Due: Three weeks after Subcontract award.

2) Schematic Design Report: ·Schematic design and analysis report, including DOE-2 results for three schematic design alternatives.
Due: 10 weeks after Subcontract award.

3) Design Development Report: Design development and analysis report, including results from revised DOE2 model.
Due: 20 weeks after Subcontract award.

4) Construction Documents Report: Compilation of Letter reports or technical notes commenting on design details, final report with DOE2 results for final design. .
Due: 30 weeks after contract award.

Technical Area 5:

3.5 Commissioning, Monitoring and Performance Verification

Subcontractor shall monitor buildings energy systems in order to characterize system performance. Scope includes monitoring of whole-building systems as well as individual components or systems. Subcontractors shall be familiar with how to design a measurement experiment to reach a stated goal, and on the instrumentation, dataloggers, and analysis techniques required for successful monitoring projects. Subcontractor shall be familiar with IPMVP and other standards for the Measurement and Verification of System Performance.

Building energy monitoring may be done under pre- and post-retrofit conditions. The degree of accuracy needed to quantify energy use will vary based on the specific project. The subcontractor will provide enough versatility to quantify building energy use using a

measurement based approach, computer simulations and/or a hand-calculation-based approach depending on available funding and degree of accuracy required. ECMs that will be evaluated include conventional energy efficiency technologies such as envelope and mechanical measures, as well as cogeneration (combined heat and power) and renewable energy technologies, such as solar heated water (both high and moderate temperature) and solar heated ventilation or process air.

Energy Monitoring and Evaluation, will generally require approximately two weeks of effort. The purpose of the Phase One effort is to gather enough data to determine or verify the performance and energy use of an existing building or buildings. The subcontractor may be asked to participate with others in determining monitoring needs and approaches. M&V of System Performance, activity will establish the performance and energy-saving characteristics of implemented ECMs at a site and determine that the systems are performing as designed.

Subcontractor shall be familiar with advanced metering technology and be able to advise facilities and agency leadership in the benefits and costs involved with employing advanced metering of utilities at a site (such as viewing electric, gas and water consumption real time on a website). Subcontractor shall assist agencies in designing metering plans.

The scope also includes building commissioning services including preparing commissioning plans, serving as a commissioning agent, or advising agencies on commissioning procurement and execution. The subcontractor shall provide building commissioning services to optimize energy efficiency, comfort conditions, and maintenance costs in Federal buildings. The subcontractor will provide Federal agency personnel with expertise in commissioning new and existing buildings. The subcontractor will be knowledgeable in commissioning practices and the design and operation of commercial building energy systems and controls. Building systems to be commissioned include central automation and energy management control systems, central plant systems, air supply and exhaust systems and controls, HVAC equipment, lighting systems and controls, emergency power systems, and renewable energy systems.

For new building commissioning, the subcontractor shall write a commissioning plan for the design phase, construction phase, or both. The plan may include: describing the building owner's project requirements such as the design intent, system performance criteria, and building acceptance criteria; identifying the systems to be commissioned during design development, construction, and occupancy; identifying the commissioning process participants and responsibilities; and developing commissioning specifications to be included as part of the overall construction specifications and bid documents. This work effort may also include reviewing system designs and specifications for commissionability and adherence to the building performance goals. If the project is applying the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) rating system, the subcontractor may be responsible for providing the submittals required for the Fundamental Commissioning prerequisite and the Additional Commissioning credit.

For existing building commissioning, the subcontractor shall perform an on-site assessment of the building energy systems and controls. Depending on the specific project, the level of effort will range from a hands-on re-tuning of the central controls to meet current occupancy and usage patterns to a more comprehensive retro-commissioning of the building's energy systems. The subcontractor shall be responsive to specific site issues such as curtailing peak electric demand, reducing annual energy costs, and comfort complaints by occupants. This work effort may also include evaluating and recommending operations and maintenance (O&M) practices to improve the building's energy efficiency. The subcontractor shall gather pertinent building data to be prepared for the site visit and submit a comprehensive report. The report shall include a detailed description of the building, assessment findings and actions, follow-on opportunities, and an estimate of energy and operations cost savings.

Sample Task for Building Monitoring

Background:
The National Renewable Energy Laboratory has been requested to provide assistance to a Federal agency facility in San Diego, California, to monitor the performance of a 20 kW grid-connected photovoltaic (PV) system. The DOE Federal Energy Management Program (FEMP) provides assistance to agencies implementing renewable energy projects at Federal facilities. This project supports both the agency and FEMP in quantifying and documenting operational benefits through monitoring the system performance.

Statement of Work:
The subcontractor shall monitor the performance of the grid-tied PV system for one year and report on energy savings (offset utility electricity usage) achieved by the system. The questions to answer about the performance of the system include:

- How much electricity did the system produce? This includes monthly and annual consumption (kWh), peak power output (kW) for each month and when that peak occurred.
- What is the corresponding offset utility cost savings? This is an estimate based on the utility rate schedule, including consumption and peak demand charges.
- What is the efficiency of the PV Array and the entire PV System?

The subcontractor shall provide and install the monitoring equipment as well as download, store, and analyze the performance data. The subcontractor shall be provided with a dedicated telephone line to connect to the monitoring equipment. The subcontractor shall also be provided with the utility rate schedule and the corresponding utility data for 1-year previous to the PV system installation.

The subcontractor shall visit the site to confirm the operational status of the PV system and install the monitoring equipment. While on site, the subcontractor shall measure array and system operational characteristics including open-circuit voltage, short-circuit

current, and an I-V Curve Trace for the entire array on the DC side (disconnected from the inverter). Long-term, the monitoring setup shall measure the AC power output from the system along with outdoor temperature and irradiance. The monitoring set-up will include the additional data points necessary to report on the power-point tracking and efficiency of the inverter.

Deliverables & Schedule:

1. Report on Operational Status and Monitoring System Installation
   This initial report shall describe the PV system including components, manufacturers, capacity (rated peak power production), and expected average daily power production. The report shall include on-site performance measurements, a description of the monitoring system, and one-month of monitored performance data. The report shall also provide a summary description of the facility and loads served by the PV system.
   Due: Two months after subcontract award (1 month after installation)

2. Quarterly Reports on PV System Performance
   These progress reports shall provide an update on the operation and performance of the PV system for the previous three months, including peak power production, daily and monthly power production, array and inverter efficiency, corresponding weather conditions, and a narrative description of any concerns or anomalies.
   Due: 5, 7, and 11 Months after subcontract award

3. Final Report on One Year of PV System Performance
   This final report shall present 1-year of measured performance results of the PV system. The report shall include an executive summary followed an in-depth presentation of the analyzed performance data. This report shall also provide an estimate of the cost savings provided by the utility demand and consumption offset by the PV system. This deliverable shall include an electronic submission of the 1-year of monitored data in spreadsheet format.
   Due: 14 months after subcontract award (13 months after installation)

Technical Area 6:

3.6 Distributed Energy Resources Systems Feasibility, Design, and Integration

Subcontractors in this category shall possess expertise and experience in distributed energy resources (DER) feasibility analysis and design integration. Distributed energy resources include reciprocating engine generators, fuel cells, microturbines, or renewable energy such as photovoltaics and wind power, deployed along with heat recovery equipment (and/or absorption cooling) in combined heat and power applications, energy storage, and associated controls. The subcontractor shall provide Federal agency personnel with expertise in any of the following tasks: feasibility assessment; technical analysis; and systems design and integration, including interconnection and permitting.

The offeror shall possess the capability to: estimate energy requirements (both electrical and thermal), simulate the performance of DER systems in different climates, given different loads, and comparison of technology options based on performance and cost trade-offs. The subcontractor shall be able to demonstrate knowledge of state-of-the-art DER technology, available hardware, system installation and maintenance procedures, and the costs associated. The contractor shall demonstrate knowledge of integration of DER technology with an existing building architecture or landscape architecture and the building structure, mechanical and electric system. The subcontractor shall also demonstrate familiarity with utility interconnection issues, including associated costs, schedule/timeline impacts, and strategies for negotiating interconnection agreements with utilities. The subcontractor shall possess the capability to prepare designs including drawings and specifications, as well as cost estimates. The subcontractor shall possess the capability to prepare procurement specifications for DER systems. The subcontractor shall advise Federal agencies on the codes and standards applicable to DER systems, including the required permits for air quality, fuels, or other regulated matters.

The subcontractor may be asked to participate in one or more of three phases of service: Phase One: Feasibility Assessment; Phase Two: Technical Analysis; and Phase Three: System Design and Integration.. In Phase One, the subcontractor will be asked to participate on a team with individuals with expertise in DER technologies to discuss the feasibility of DER for a given application. The subcontractor would be responsible for collecting enough data about the facility or site in order to make a preliminary assessment whether to pursue the option further and provide advice on potential implementation strategies. Phase Two technical analysis is a preliminary assessment to determine the technical and economic feasibility of a specific project at a specific facility. The Phase Three effort involves design, integration and the development of procurement specifications for a DER system. It also involves developing a procedure for on-going maintenance of the system at the facility. The Phase Three analysis would not occur until the client has explored several opportunities and made the decision that a DER system would meet their needs for a specific application.

Sample Task: Distributed Energy Resources (including Combined Heat & Power)

Background:
The National Renewable Energy Laboratory has been requested to provide assistance to the National Park Service in evaluating distributed generation opportunities at Death Valley National Park. Pacific Bell (PacBell) currently operates a cell phone tower in Death Valley National Park. The cell phone tower is powered by grid electricity supplied from Southern California Edison. PacBell requires back-up power for their cell phone tower, estimated to require approximately 20 kW 24 hours per day, and three days of backup power are required, although there has never been an outage at the site that has lasted three days. PacBell's typical backup energy source is a propane generator set. However, the NPS would like to investigate other options, namely due to the proximity of their park air monitoring equipment to the cell phone tower (and therefore any

subsequent backup power generation). Any fossil fuel backup power generation equipment could negate the air quality statistics taken in the park, if the equipment happens to be running when the air monitoring data is being taken. The NPS would like to investigate using solar photovoltaics (PV) as either a backup power system, or to take the cell phone tower completely off-grid. The analysis generated here will then be used by the NPS in working with PacBell on an optimum backup power solution.

Statement of Work:
The subcontractor shall complete the following tasks:

1) Analyze the use of a PV system to a) provide backup power when the grid is not available, and b) provide all the power necessary to take the cell phone tower off-grid. Generate a life-cycle cost analysis of each option, and provide the simple payback period.
2) In evaluating 1) above, consider any available rebates for the grid-connected system, and any ancillary benefits that might come from taking the system off-grid.
3) For the grid-connected system, provide the necessary interconnection requirements documentation and discuss the steps and costs involved in interconnecting the system to the grid.
4) For the off-grid system, discuss any exit fees or other penalties that might be incurred by taking the system off of the Southern California Edison electric grid.

Deliverables:

1) Draft Report. The subcontractor shall provide a draft report, addressing all of the tasks noted in the scope of work. The technical monitor and the NPS shall have one week to provide comments, ask questions, or require edits.

2) Final Report. The subcontractor shall provide the final report, addressing all of the tasks noted in the scope of work, and all the comments provided by the technical monitor and the NPS.

4.0 Submission of Deliverables:

FEMP provides a standard report format, included as Attachment 1 of this Statement of Work, which outlines the information generally required in each report. Deliverables shall be provided as follows:

Electronic Reporting Requirements for Subcontract Report Deliverables:

As set forth in Department of Energy Order 241.1A, NREL is required to submit in an electronic format all scientific and technical information, including subcontract report deliverables intended for public distribution, to the DOE Office of Scientific and Technical Information (OSTI). In addition, it is NREL's intention to post subcontract report deliverables containing publicly available information (e.g. non-confidential, non-

protected, non-proprietary information) for distribution on the NREL Intranet or the Internet.

The Subcontractor shall provide the final approved version of report deliverables intended for public distribution as specified in the deliverables schedule of this Statement of Work in accordance with the following electronic reporting requirements:

a. The Subcontractor shall submit all report deliverables intended for public distribution (including status, annual, or final reports) as electronic files, preferably with all graphics and images embedded within the document. The electronic files shall be submitted along with an accompanying hard (printed) copy(ies) of the report. Limited exceptions allowing some graphics and images to be submitted as hard copies only may be granted on a case-by-case basis. The exceptions process for graphics and images is described in Paragraph E below. It shall be made clear in the deliverable transmittal letter that certain graphics and images are supplied in hard copy only.

b. All final approved version submissions shall be delivered to NREL on PC or MAC-formatted media (3.5 inch disks, Zip and Jaz cartridges, or CD-ROM). Files of 1 Mb or less can be sent via e-mail to the 1) NREL technical monitor, 2) the NREL Subcontract Administrator or Associate (as specified in the Statement of Work).

c. The preferred format is a single electronic file that includes all of the text, figures, illustrations, and high-resolution digital photographs (or photographs should be scanned and incorporated in the text). Acceptable file formats are:

- Microsoft Word (v.6.0 or newer for PC or MAC)
- WordPerfect (v.6.1 or newer for PC)
- Microsoft PowerPoint
- Microsoft Excel

d. If it is not possible to include all of the graphics and images (figures, illustrations, and photographs) in the same file as the text, NREL will accept the text in one of the above formats and the graphics and images as separate electronic graphic or image files*. The native files for any page layout formats submitted shall be supplied. The following software is supported on both Mac and PC platforms:

- QuarkXPress (.qxd)
- Photoshop (.psd)
- Freehand (.fh)
- Framemaker (.fm)
- Pagemaker (.pm)
- Illustrator (.ai)
- Corel Draw (.cdr)
- Microsoft Publisher(.pub)

*The acceptable graphic or image file formats are: .eps, .tif, .gif, .jpg, .wpg, .wmf, .pct, .png, .bmp, .psd, .ai, .fh, .cdr. The preferred resolution for graphics or images is 150 to 300 dpi. Include all fonts that were used in creating the file.

e. In the rare case that the graphics or images cannot be supplied electronically, either incorporated within the text or as a separate electronic file, original hard copies will be accepted. The Subcontractor shall obtain prior approval from the Subcontract Administrator before submitting graphics or images in hard copies. It shall be made clear in the deliverable transmittal letter that certain graphics and images are supplied in hard copy only.

f. For all calculations in support of subcontract reports that are conducted in ASPEN+, an electronic copy of INPUT, REPORT and BACKUP (if Model Manager is used) must be submitted with all reports. Additionally, if costing or sizing calculations are conducted in a spreadsheet [no process calculations (heat and material balances) in spreadsheet format are permitted], a copy of the fully documented MS Excel file shall be supplied. Note that vendor quotes and other non-original material can be supplied in hard copy.

g. A fully executed release shall be supplied to NREL with all photographs, regardless of whether such photographs are delivered to NREL electronically or in hard copy. Such release shall certify that the National Renewable Energy Laboratory and the United States Government is granted a non-exclusive, paid-up, irrevocable, worldwide license to publish such photographs in any medium or reproduce such photographs or allow others to do so for United States Government purposes.

h. The Subcontractor may contact NREL Publication Services at (303) 275-3644 with questions regarding technical guidance concerning the submission of subcontract report deliverables as electronic files or exceptions to electronic files for graphics and images.

Deliverable Addresses - The Subcontractor shall clearly label all deliverables with the subcontractor name, NREL subcontract number, NREL Technical Monitor name, date, and the deliverable description (e.g., First Monthly Report, Draft Final Report). Deliverables shall be sent to the following addresses:

National Renewable Energy Laboratory
Attn: NREL Technical Monitor, MS ****
1617 Cole Blvd.
Golden, CO 80401
****Email Address

- One (1) master electronic version
- One (1) master printed copy, including graphics, and one copy

National Renewable Energy Laboratory
Attn: Mercedes Amador, MS 2713
1617 Cole Blvd.
Golden, CO 80401
mercedes_amador@nrel.gov

- One (1) master electronic version;
- One (1) printed copy, including graphics

NREL Publication Services, MS 1713
National Renewable Energy Laboratory
1617 Cole Blvd.
Golden, CO 80402
judy_hulstrom@nrel.gov

- One (1) master electronic version;
- One (1) master printed copy, including graphics

ATTACHMENT 1

TECHNICAL ASSISTANCE REPORT

C O V E R S H E E T I N F O R M A T I O N

AGENCY: _____

LABORATORY: _____

LAB POINT OF CONTACT: _____

PHONE: _____ **FAX:** _____

EMAIL: _____

REGIONAL OFFICE: _____

RO POINT OF CONTACT: _____

PHONE: _____ **FAX:** _____

EMAIL: _____

DATE OF COMPLETION OF REPORT: _____

TECHNICAL ASSISTANCE REPORT FORMAT

Executive Summary

Brief TA description / Task Outline
Key baseline assumptions
Table of all ECMs, cost, annual savings, and simple payback

Goals

Define the objective of the effort.

Base Case

Recommendations

1. Provide a discussion of each ECM. Provide a brief explanation of the technology and the benefits.

ECM–1
ECM-2
ECM-3
.
.
x. ECM-X

2. Combined ECMs. Account for interactions.

Discussion

Discussion on implementation to include topics such as funding source, agency actions to implement, and predicted implementation schedule.

Tables

To include to include info collected in the spreadsheet, in addition to:
ECM(or Project), Annual Energy Savings (Site MMBtu/yr), Fuel Source,
Annual Energy Cost Savings ($/yr), Ancillary Cost Savings ($/yr),
Implementation Cost ($), Implementation Date, ECM Service Life (yrs), Simple Payback, and Savings-Investment Ratio (optional), standardize and clarify savings numbers (don't mix non-energy with energy cost savings), ECM Interaction.

Figures

Appendix